

In US Patent No: 4,089,773, issued May 16, 1978, Espenscheid disclosed the Invention of "**Liquefaction of solid carbonaceous materials**", the Abstract of which reads as follows:

Abstract

This invention provides an improved process for solubilizing coal and other solid carbonaceous materials which involves heating a slurry of comminuted carbonaceous material and liquefaction solvent in contact with water, carbon monoxide, and a catalytic quantity of alkanol to produce a heavy oil or bitumen composition.

In US Patent No: 4,108,758, issued August 22, 1978, Schoennagel , et al. discloses the Invention of "**Conversion of coal into liquid fuels**", the Abstract of which reads as follows:

Abstract

This invention provides an improved process for deriving liquid fuels from coal which involves the steps of (1) solubilizing coal in a FCC residual oil to form a solvated coal solution phase and an ash solids phase; (2) subjecting the two phase admixture to FCC conversion conditions; (3) separating and recovering a hydrocarbon phase and a catalyst-ash solids phase; (4) treating the catalyst-ash solids phase in a catalyst regeneration zone, and removing entrained ash solids from the flue gas effluent of the catalyst regeneration zone; and (5) fractionating the hydrocarbon phase to recover liquid fuel products.

In US Patent No: 4,159,857, issued July 3, 1979, Doehlert discloses the Invention of "**Producing fluid fuel from coal**", the Abstract of which reads as follows:

Abstract

In a coal liquefaction system, product B.T.U./hr. can be significantly increased by dividing the coal to be treated into two portions, liquefying one portion, and adding the other portion to the product of the liquefaction process to produce a suspension for use as a fuel. The process is carried out by adding conventionally available equipment to a coal liquefaction plant, and the total plant is far less expensive to build and operate than a conventional liquefaction plant having the same production in terms of product B.T.U./hr.

In US Patent No: 4, 191,629, issued March 4, 1980, Chervenak discloses the Invention of the "**Reactor residuum concentration control in hydroconversion of coal**", the Abstract of which reads as follows:

Abstract

A **process for the hydrogenation of coal** at elevated temperature is disclosed, wherein particulate coal having an average particle size of less than 1000 microns is admixed with a liquid hydrocarbon to form a slurry containing about 30-50 weight percent solids, and the slurry is passed to an ebullated bed reactor wherein the coal is catalytically hydrogenated at reactor pressure of about 100 to 300 atmospheres to produce hydrocarbon products, including a liquid residuum containing unconverted processed coal solids. The improved process includes the steps of removing the hydrocarbon products from the reactor; reducing the pressure of the hydrocarbon products not more than 10% below reactor pressure to separate the hydrocarbon products by phase separation of the gaseous components from the liquid component containing residuum and unconverted coal solids; dividing the

liquid into a stream for liquid-solids separation and a bypass stream; passing a portion of the liquid residuum to a liquid-solids separator at substantially the same temperature as the phase separating step; recovering from the separator a purified liquid product stream containing a substantially reduced concentration of unconverted coal solids combining a sufficient amount of the bypass stream with the solids reduced stream to maintain the desired levels of solids and residuum in the reactor; recycling the purified liquid product stream to the ebullated bed reactor in a liquid handling system wherein the pressure throughout the process is maintained at least 90% of the reactor pressure; and recovering from the cyclonic separator a second liquid product stream containing 25 to 45 weight percent unconverted coal solids.

In US Patent No: 4,214,974, issued July 29, 1980, Wurfel discloses the Invention of "**Process for hydrogenation of coal**", the Abstract of which reads as follows:

Abstract

The invention is an improvement in the process for hydrogenation of a finely divided coal and oil slurry wherein the improvement comprises subjecting the hydrogenation products to a first phase separation to obtain a liquid fraction and a gaseous fraction. The gaseous fraction is subjected to a second phase separation to obtain a liquid fraction having a boiling range between about 200.degree. C. and about 500.degree. C., which fraction is used to preheat the coal and oil slurry by direct mixing therewith.

In US Patent No: 4,318,797, issued March 9, 1982, Jager , et al. discloses the Invention of "**Process for converting coal into liquid products**", the Abstract of which reads as follows:

Abstract

The invention provides a process and an apparatus for hydrogenative liquefaction of coal to produce high yields of gasoline fraction and optional yields of diesel and residue fraction, all of superior quality. The coal is slurried and digested in two separate and distinct streams. The parting oil of the first stream is heavy residue fraction derived to a substantial extend from the second stream, mixed with light oil derived partly or wholly from the first stream. The pasting oil of the second stream is middle oil derived from the fractionated discharge of the first stream, any shortfall being made up from the discharge of the second stream. A high degree of flexibility is possible by varying the ratio of coal fed to the respective streams between 3:1 and 1:3, and individual manipulation of the process parameters within each stream in respect of pressure, temperature, catalyst, residence time, pasting oil composition and coal quality.

In US Patent No: 6,237,510, issued May 29, 2001, Tsumura, et al. discloses the Invention wherein the first portion of **Claim 1** reads as follows:

What is claimed is:

1. A combustion burner comprising:

a mixture nozzle defining a mixture fluid passage through which a **mixture fluid containing a powdered solid fuel** and a conveyor gas for transferring said solid fuel flows toward a furnace;